The Phylogenetic Position of *Edrotes* and A New Species of the Genus

(Coleoptera : Tenebrionidae)

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The highly modified, eremophilous (desert loving) beetles constituting the genus *Edrotes* LeConte, occur only in North America. Nearly twenty species have been described, mostly by Casey (1907, 1924). Subsequently all names but *E. rotundus* (Say) and *E. ventricosus* LeConte were synonymized by La Rivers (1947), who described a third species, *E. arens*. Both *E. ventricosus* and *E. rotundus* are widely distributed throughout the southwestern United States and northern Mexico, each displaying a confusing variation in size and morphological detail among populations from different portions of its range. The species *E. arens*, occurring only in arenaceous areas of southeastern California and probably adjoining areas in Arizona and Mexico, exhibits a distinct and constant morphotype. The species described here is probably limited to the red-rock region of Utah, Arizona, New Mexico, and Colorado.

The following key, modified from La Rivers (1947) will separate the four species of *Edrotes*:

1. Dorsal vestiture of long, erect, slender setae, interspersed with shorter, more or less recumbent setae 2
   Dorsal vestiture of short, appressed, scale-like setae, each widest at the middle ..... *arens* La Rivers
2. Dorsum of elytra, prothorax and head tuberculate 3
   Dorsum of elytra, prothorax and head coarsely punctate ..... *rotundus* (Say)
3. First protarsal segment expanded into a blunt, spatulate process (Fig. 1); length usually less than 7 mm ..... *leechi*, new species
   First protarsal segment cylindrical, truncate, lacking a spatulate process; length usually greater than 7 mm ..... *ventricosus* LeConte

Edrotes leechi Doyen, new species

(Figs. 2, 3)

General form globose, highly convex, light reddish-brown to nearly black; dorsum of elytra, prothorax and head sparsely clothed with long, erect, white setae; entire body, except portions of legs, cranium and mouthparts, densely clothed with shorter, recumbent setae.

Head amplected into prothorax up to eyes; dorsally clothed with few long and many short setae, each anteriorly directed and arising anterior to a small tubercle; coarsely punctate ventrally, each puncture bearing a short, anteriorly directed

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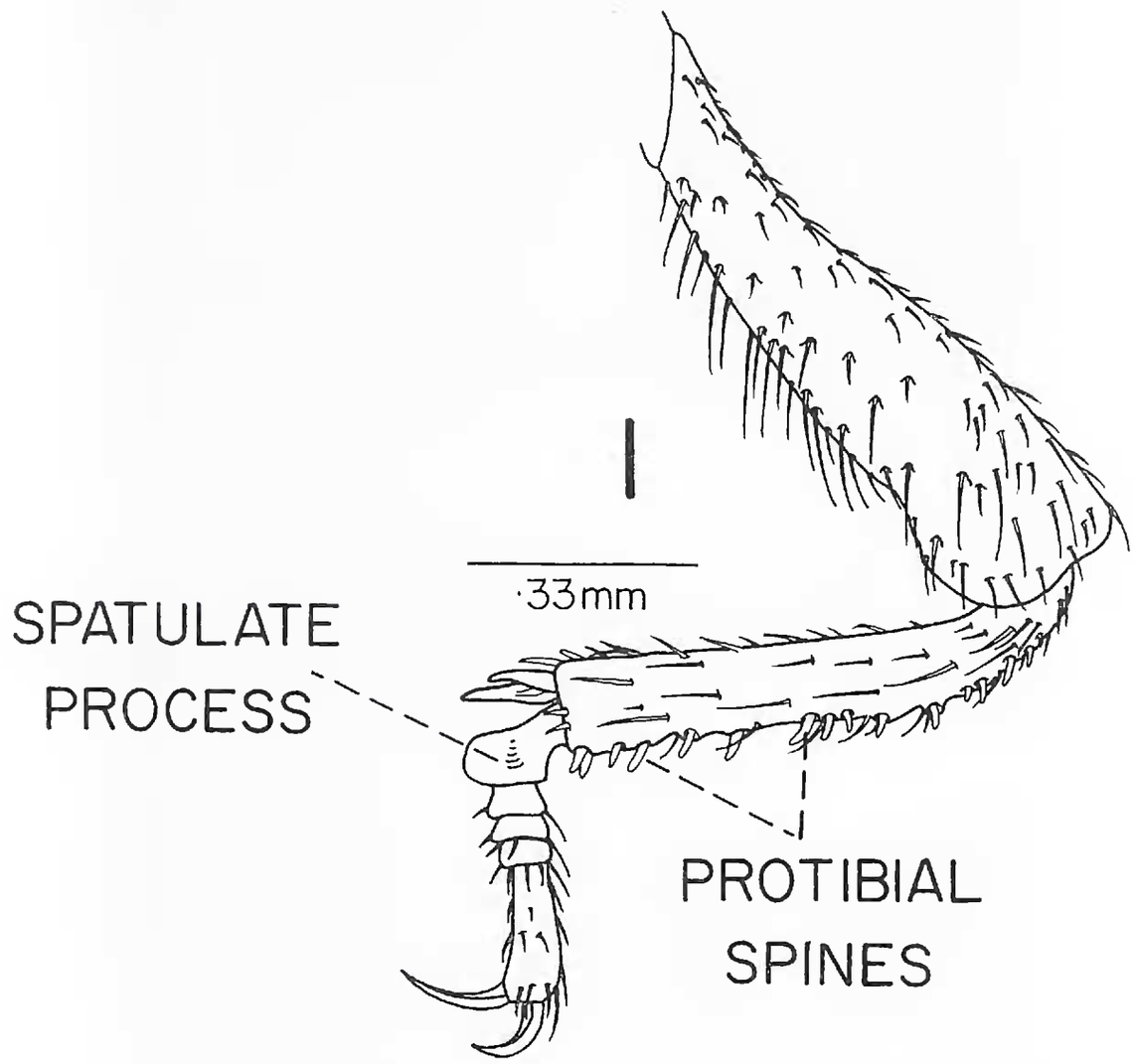

FIG. 1. Anterior view of foreleg of *Edrotes leechi* Doyen, illustrating tibial and tarsal modifications.

seta; epistoma nearly quadrate, anterior edge straight or slightly emarginate; labrum distinctly emarginate; anterior angle of supraantennal ridge obtusely rounded; dorsal mandibular tooth obsolete, barely clasping epistoma; eyes nearly round; pregular cavity subequal in width to mentum; antennae slender, third segment longest, subequal to length of fourth and fifth combined, apical four segments slightly expanded, forming a very loose club, last five segments covered with very fine pile, ultimate segment abruptly tapering to point; mentum emarginate anteriorly; ultimate segment of maxillary palpi awl shaped or weakly securiform, equal to or longer than penultimate.

Prothorax narrow, transverse and convex, markedly depressed dorsally before elytra, anterior angles acute (about 45°), projecting almost to anterior margin of eye; tuberculations on disk larger than those on cranium; setae medially directed with long setae more abundant than on head; very coarsely punctate ventrally, each puncture bearing a very short, posteriorly directed seta; prosternal process narrower than width of procoxal cavity, declivous behind coxae.

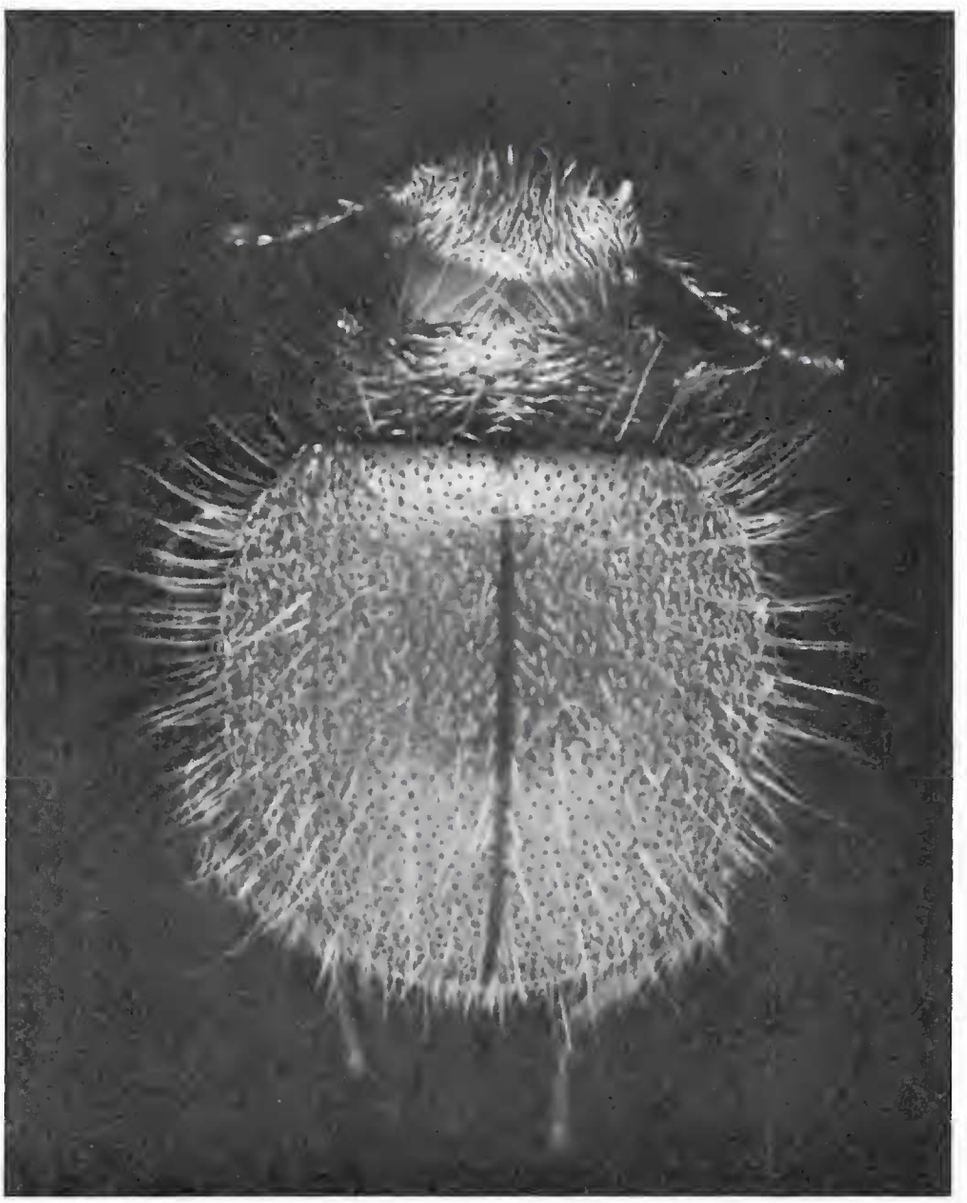

FIG. 2. *Edrotes leechi* Doyen, holotype, 15×. (Photograph by A. Blaker.)

Elytra slightly longer than wide; vestiture as on pronotum, but setae directed posteriorly, long setae most abundant on lateral margins, absent on ventral, deflexed surfaces of elytra; epipleural ridge arcuate and minutely serrate, obsolete from point slightly anterad of metacoxa, epipleura each with a single series of setae, each set posterior to a tubercle; scutellum obsolete.

Mesosternum and metasternum very coarsely punctate laterally, tuberculate medially, a short, posteriorly directed seta in each puncture or behind each tubercle; mesosternum declivous anteriorly, meeting prosternal process; mesocoxae separated by less than width of mesocoxa; median metasternal groove absent; abdomen with sternites narrow, transverse, arcuate; intercoxal process obtusely angulate or rounded; abdominal sternites uniformly clothed with short, posteriorly directed setae, each set posterior to a tubercle.

Legs moderately long, femora barely extending beyond lateral body margins; femora clavate, sparsely fringed ventrally with moderately long setae; tibiae arcuate basally, slightly thickened apically, fringed (except protibiae) dorsally

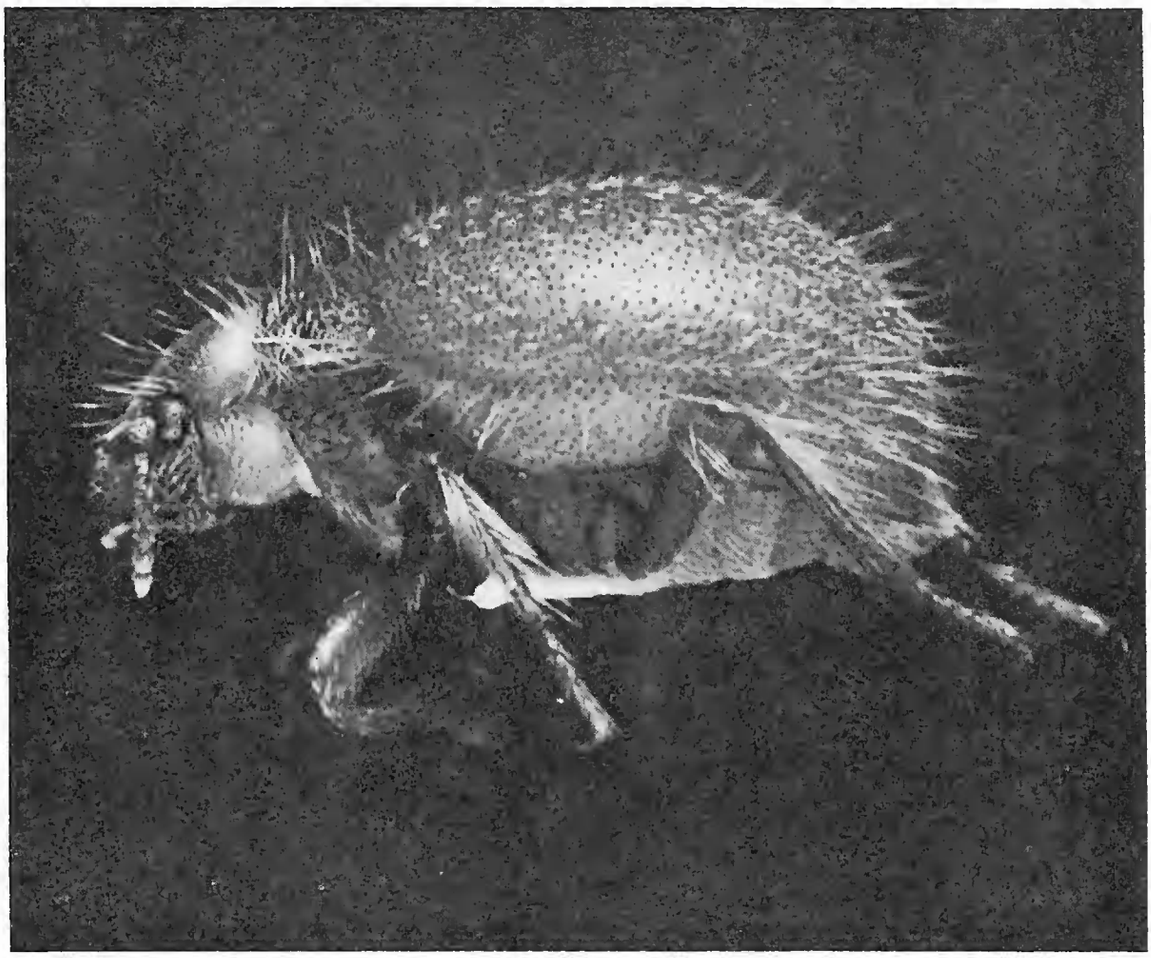

FIG. 3. *Edrotes leechi* Doyen, holotype, 15×. (Photograph by A. Blaker.)

with moderately long setae; protibiae serrate dorsally, each serration bearing a blunt, curved spine; first protarsal segment expanded ventrally into a blunt, spatulate process; ultimate segment as long as first four combined; tarsal claws slender, arcuate, nearly as long as ultimate tarsal segment.

Sexes externally identical.

Mean length (elytra and prothorax) of 20 specimens: 4.37 mm; standard deviation: 0.39 mm; range: 3.45 to 5.10 mm. Mean width (elytra at broadest point): 3.48 mm; standard deviation: 0.26 mm; range: 2.80 to 3.85 mm.

Holotype female, allotype male from DEVILS GARDEN CAMPGROUND, ARCHES NATIONAL MONUMENT, GRAND COUNTY, UTAH, 25 August 1965, John T. Doyen (California Academy of Sciences); 15 paratypes, sex not determined, same data as holotype; 1 paratype, Joseph City, Navajo County, Arizona, 24 August 1952, H. B. Leech (California Academy of Sciences and Brigham Young University).

I take great pleasure in naming this species in honor of Hugh B. Leech, of the California Academy of Sciences. This species most closely resembles *E. rotundus* in size and facies, but the integument of the latter is coarsely punctate. The marked depression between the pro-

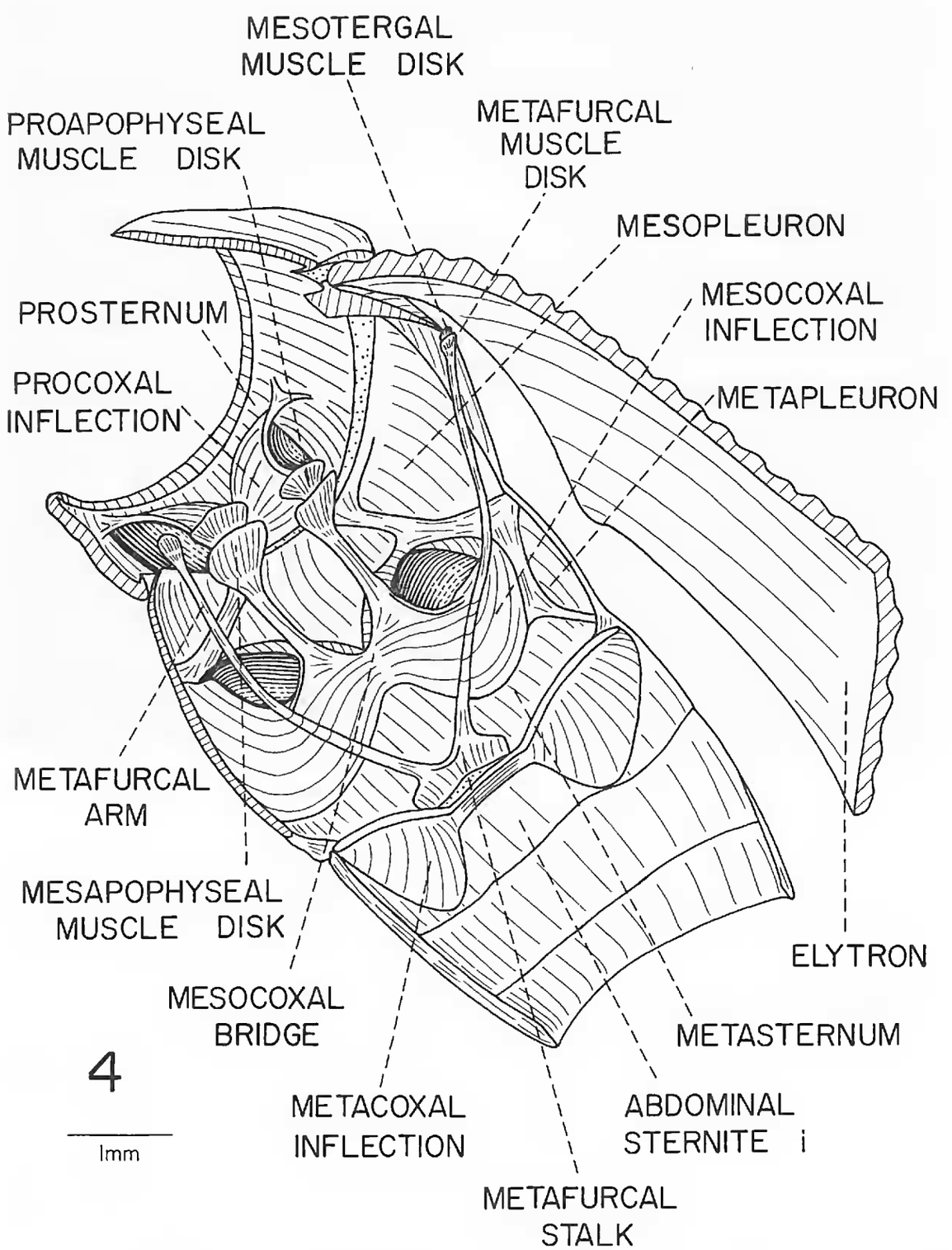

FIG. 4. *Adesmia nassata* Erichson. Oblique dorsal view of internal skeletal structures of thorax. Cut edges represented by hatching.

thorax and elytra and the protarsal and protibial modifications will separate *E. leechi* from all other described species of *Edrotes*.

The structure of the fore leg of *E. leechi* is similar to that of other arenicolous Tenebrionidae, such as *Coelus*, of the maritime sand dunes

of the Pacific coast (see Koch, 1955, for several other examples). *Edrotes arens*, limited to arenaceous areas of the eastern California deserts has extremely long, coarse setae on the ventral tarsal surfaces, an adaptation also present in other arenicolous Tenebrionidae, while *E. rotundus* and *E. ventricosus* lack such modification, but have a much wider distribution. This evidence suggests that *E. leechi* may be limited to the four-corners area of Utah, Arizona, New Mexico, and Colorado, where extensive areas of fine, wind-blown sand exist.

Stridulation in Edrotes

All described species of *Edrotes* are able to stridulate. This is accomplished by rubbing the metafemora, which are finely ridged on the medial surface, over the minutely serrate epipleural ridges. Stridulation may be induced by holding the beetles between the fingers. The biological significance of stridulation in *Edrotes* is not understood, but it is of phylogenetic interest, as indicated below.

The Relationship of Edrotes to Epiphysa

The members of the genus *Edrotes* bear a striking resemblance to the members of the south African genus *Epiphysa* Blanchard. Koch (1955) favors including both *Edrotes* and *Epiphysa* in the tribe Adesmiini because of the basic similarity of *Epiphysa* to members of that tribe. Although it is frequently impossible to determine whether external similarities of the sort shared by *Edrotes* and *Epiphysa* result from convergence or common ancestry, detailed morphological comparisons sometimes expose major divergences. Study of *Edrotes ventricosus* LeConte, *Adesmia nassata* Erichson, *A. variolaris* Olivier, *Epiphysa flavicollis* Fabricius and *E. latisterna* Koch[1] has revealed several basic structural differences between the Adesmiini (including *Epiphysa*) and *Edrotes*, indicating that *Edrotes* does not have a close affinity to the Adesmiini and that the tribe Edrotini should be retained until more definitive studies have been made. Morphological terminology follows that employed by Doyen (1966).

Despite the general external similarity of *Edrotes* to *Epiphysa*, there are several differences, of which the most obvious are the lack of the epipleural stridulatory apparatus in *Epiphysa* and the absence in *Edrotes* of the ventral, prothoracic grooves which receive the antennae in *Epiphysa*. Casey (1907) points out some other, minor external differ-

[1] Due to its rarity in collections, only partial dissections of *Epiphysa* could be made. Accordingly, illustrations were made of *Adesmia nassata* and *A. variolaris*, which are quite similar internally to *Epiphysa*.

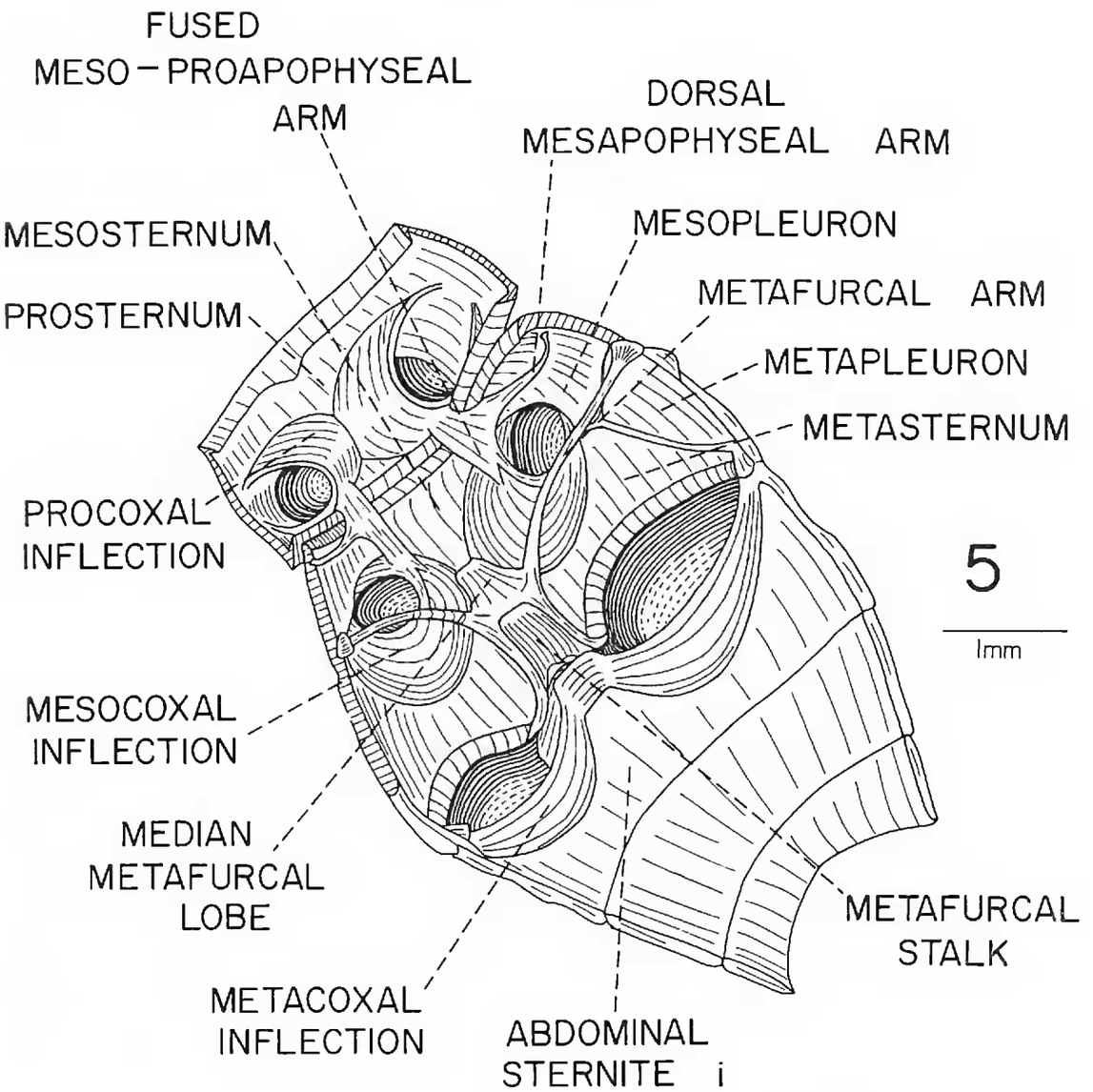

FIG. 5. *Edrotes ventricosus* LeConte. Oblique dorsal view of internal skeletal structures of thorax. Cut edges represented by hatching.

ences between the two genera, but the most obvious ones are found internally and in the female genitalia.

Like many other flightless Tenebrionidae, both *Edrotes* and *Epiphysa* exhibit an extreme modification of the endoskeleton. Significantly, these modifications are quite dissimilar, although the endoskeletal structure of *Epiphysa* is very similar to that of *Adesmia*. In *Epiphysa* and *Adesmia* the metafurcal stalk is very short, splitting into the metafurcal arms just anterad of the metacoxae (Fig. 4). In *Edrotes* the stalk curves anterodorsad, nearly reaching the mesocoxal inflections before splitting into the metafurcal arms (Fig. 5). From the anterior end of the metafurcal stalk of *Edrotes* a broad horizontal projection extends anterad along the midline, usually reaching and fusing with

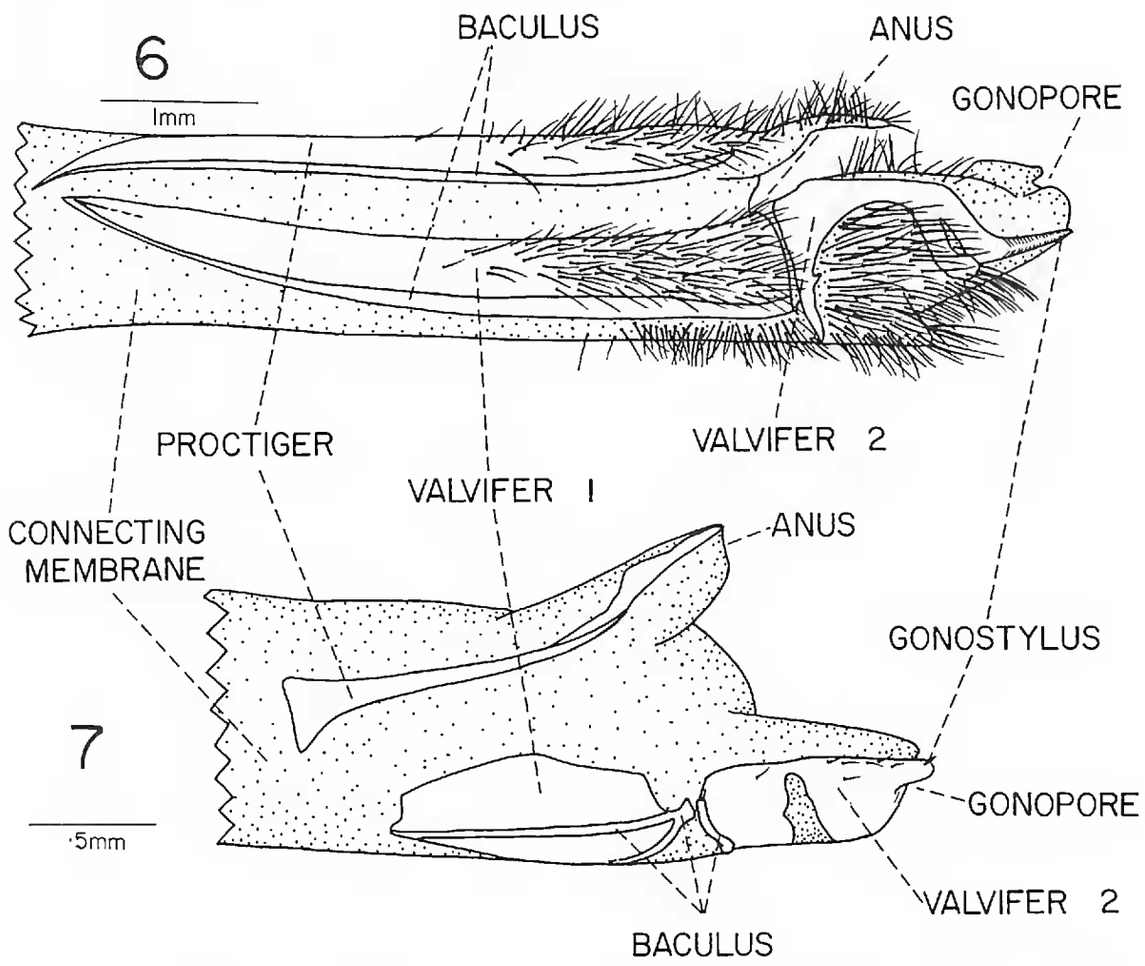

FIG. 6. *Adesmia variolaris* Olivier. Ovipositor, lateral view. FIG. 7. *Edrotes ventricosus* LeConte. Ovipositor, lateral view.

the mesocoxal inflections. In *Adesmia* and *Epiphysa* this median lobe is absent or occasionally represented by a pair of short projections that do not reach the mesocoxal inflections. The median lobe may represent the fused anterior tendons, which support ventral longitudinal muscles arising on the mesocoxal inflections in winged Tenebrionidae.

In all three genera the metafurcal arms thrust horizontally anterolaterad to fuse with the mesocoxal inflections, then each continues anterodorsally, terminating as a rounded flange. In *Epiphysa* and *Adesmia* (Fig. 4) this flange is attached by a short muscle or ligament to a similar flange on the mesotergum or on the dorsal edge of the mesepimeron. In *Edrotes* (Fig. 5) the metafurcal arm is relatively much shorter, due to the greater length of the stalk, and the flange is fused to the cuticle of the mesopleuron at the point where the coxopleural suture intersects the edge of the elytron.

The mesosternal apophyses are greatly modified in both the Edrotini

and the Adesmiini, though quite differently. In *Adesmia* the mesapophyseal arms extend horizontally anterad to the mesothoracic foramen, terminating as large, vertically oriented disks which are fused ventrally to the anterior edge of the mesosternum. Opposed to these and connected to them by short, thick muscles are a pair of similar disks formed by the prosternal apophyses. These structures are similar in *Epiphysa,* except that a greater degree of coalescence is present. The procoxal inflections, fused only along their adjoining medial walls in *Adesmia,* are broadly connected by a transverse cuticular bridge in *Epiphysa.* The mesapophyseal and proapophyseal muscle disks are fused in the latter, forming a single pair of large, vertical protuberances, broadly joined to the anterior edge of the mesosternum. Because of the greater shortening of the mesothorax, the mesapophyseal arms are relatively much shorter in *Epiphysa.* In both genera a strong cuticular bridge joins the mesocoxal inflections.

In *Edrotes* neither the mesocoxal nor procoxal inflections show any traces of the transverse cuticular bridges present in the Adesmiini. The mesapophyseal arms extend horizontally anterad as in the Adesmiini, but fuse evenly with the prosternal apophyses, with no trace of the conspicuous muscle disks of the latter group. The uninterrupted cuticular rods connecting the mesocoxal and procoxal inflections of *Edrotes* rigidly fuse the prothorax to the mesothorax. Rigidity is attained in *Epiphysa* by the fusion of the opposed muscle disks, and in *Adesmia* the articulation between prothorax and mesothorax remains flexible. In *Edrotes,* midway along the mesapophyseal arms, just posterior to the mesothoracic foramen, a pair of very slender branches splits off dorsally, coursing to the vicinity of the vestigal elytral articulations. These dorsal arms have no corresponding structure in *Epiphysa* or *Adesmia.*

Edrotes and *Epiphysa* diverge rather markedly in the structure of the female genitalia. In both forms the ovipositor is a membranous tube strengthened dorsolaterally by the sclerites of the proctiger, ventrolaterally by the first valvifers and apically by the second valvifers. Both the first valvifers and the proctiger are simple plates, similar to their homologs in *Tenebrio,* while the second valvifers are specialized, probably for digging, in *Epiphysa* and *Adesmia* (Fig. 6), though not in *Edrotes* (Fig. 7). In the latter the second valvifer remains a weakly sclerotized plate, attenuating to a blunt, very weakly sclerotized lobe bearing the terminal gonostylus. The second valvifer articulates by a narrow basal baculus with the first valvifer. The second valvifer of *Epiphysa* and *Adesmia* is much more strongly sclerotized, the baculus

curving posteriad and ending as a large, flattened, spinate process, apparently the highly modified gonostylus. Most of the apical surface of the ovipositor is densely beset with long, fine setae, while that of *Edrotes* is sparsely setate or nearly glabrous.

Clearly, *Epiphysa* should be regarded as a member of the Adesmiini, not only because of the general morphological similarity noticed by Koch, but because of the high correspondence of the specialized structures described here to those of the Adesmiini. *Edrotes* could have diverged from the adesmiine stock only before certain adesmiine features, such as the ovipositor and thoracic endoskeleton had appeared. The superficial similarity of *Edrotes* to *Epiphysa* would then be the result of convergence, whether or not the latter is considered a member of the Adesmiini. Detailed morphological study of the Triorophini, Craniotini and other tentyriine tribes from both North America and Africa will probably be necessary to reveal the affinities of *Edrotes*.

Acknowledgments

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